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Spatial segregation impact on star formation in nearby dwarf spheroidal galaxies ⋆

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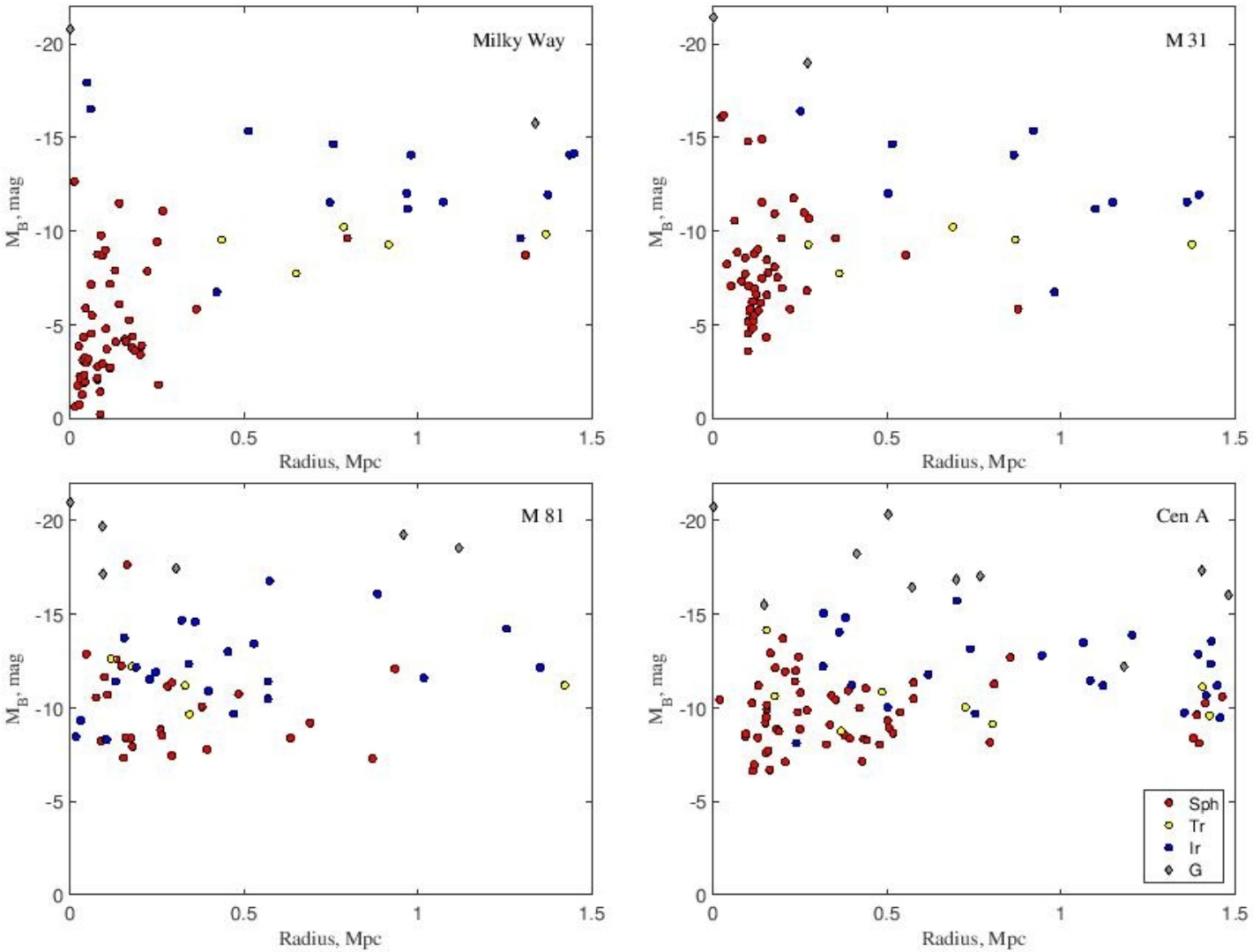
ABSTRACT
Using our HST/ACS observations of the recently found isolated dwarf spheroidal galaxies, we homogeneously measured their star formation histories. We determined star formation rate as a function of time, as well as age and metallicity of the stellar populations. All objects demonstrate complex star formation history, with a significant portion of stars formed 10–13 Gyr ago. Nevertheless, stars of middle ages (1–8 Gyr) are presented. In order to understand how the star formation parameters influence the evolution of dSphs, we also studied a sample of nearest dSphs in different environment: isolated ($d < 2$ Mpc); beyond the Local Group virial radius (but within the Local Group zero velocity sphere); and the satellites of M 31 located within the virial zone (300 kpc). Using archival HST/ACS observations, we measured their star formation histories. A comparative analysis of the parameters obtained allow us to distinguish a possible effect of the spatial segregation on the dSphs evolution scenario.

Та самая сегрегация



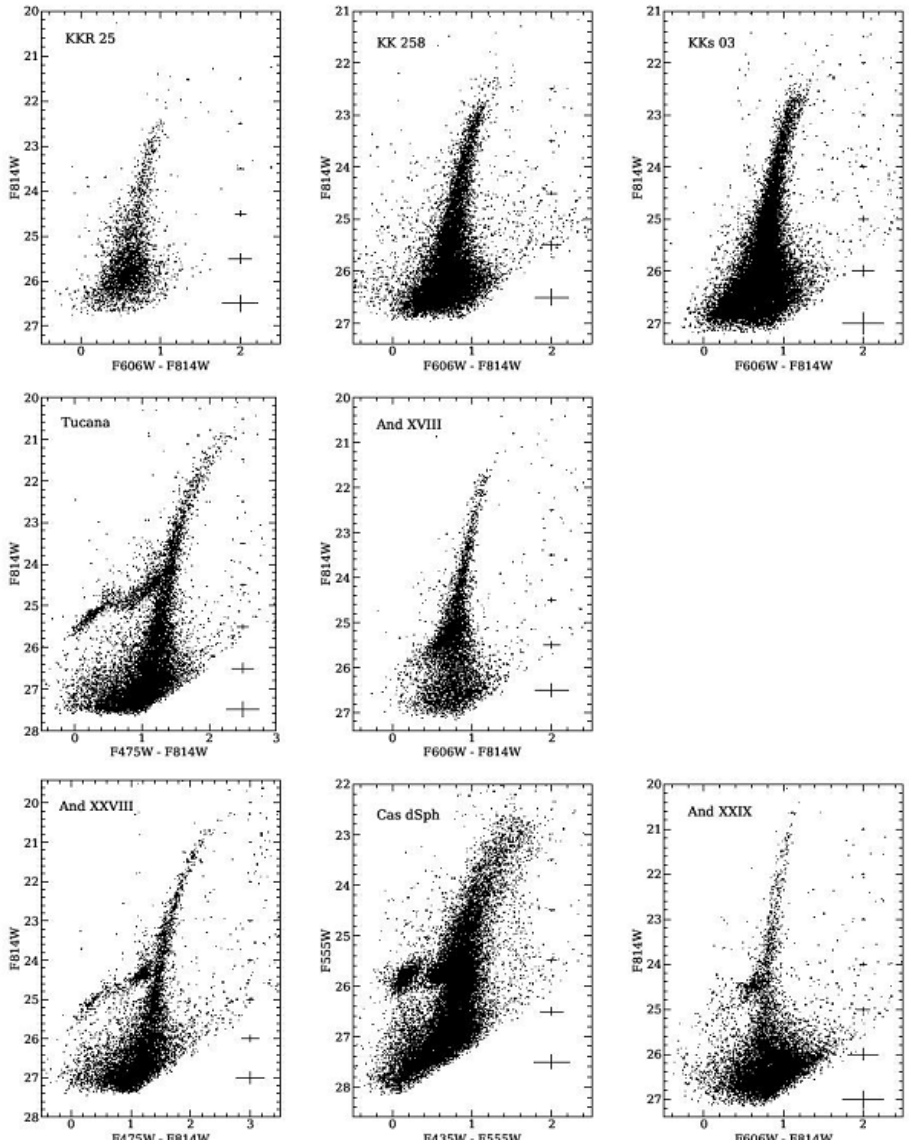
Но есть и среди изолированных карликовые сфероидальные…

Table 1. General parameters of the sample galaxies

Name	R.A. Decl (J2000)	Type	M_B mag	a26 '	D Mpc
KKR 25	161347.7+542215	dSph	−9.44	1.10	1.91
KK 258	224043.8−304758	dTr	−10.51	1.70	2.24
KKs 03	022443.5−733049	dSph	−10.72	2.45	2.00
.....					
Tucana	224149.0−642512	dTr	−9.26	2.88	0.92
And XVIII	000214.5+450520	dSph	−8.73	1.60	1.31
.....					
And XXVIII	223241.2+311258	dTr	−7.72	1.70	0.65
Cas dSph	232631.8+504032	dSph	−11.76	3.02	0.82
And XXIX	235855.6+304520	dSph	−7.52	2.70	0.73

the dSphs within the zero velocity radius, but outside the virial radius Tucana dwarf and And XVIII; the dSphs within the virial radius of M 31 And XXVIII, Cas dSph and And XXIX.

HST: диаграммы Герцшпрунга-Рессела (CMD)



Восстановленные истории SF

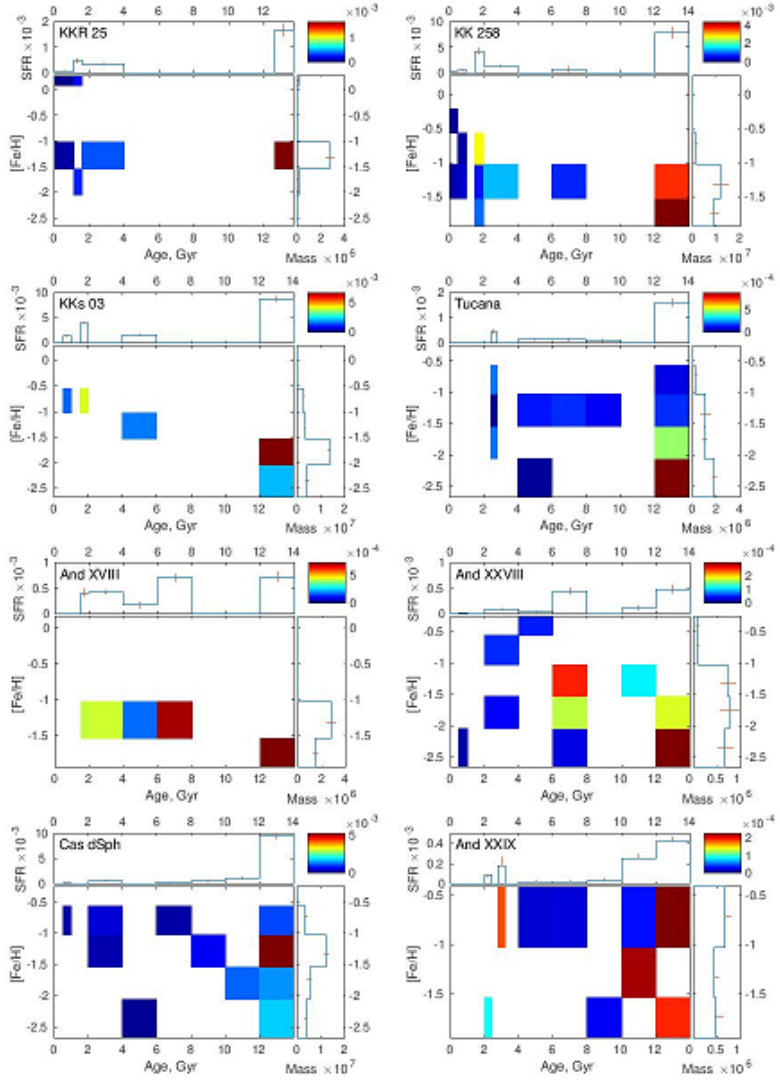


Figure 3. Star formation histories of the dSph galaxies of our sample. Three panels are given for each galaxy: the upper one shows the star formation rate (SFR) dependence (in the units of solar masses per year, $M_\odot\,yr^{-1}$) on the age of the stellar populations (in billions of years, Gyr); the bottom panel represents the metallicity [Fe/H] of the stellar component as a function of age, where the coloured rectangles correspond to the estimated periods of star formation; the right panel shows the measured mass of stars of the respective metallicity. The formal errors of our calculations are indicated as vertical bars.

Количественные характеристики историй звездообразования

Name	D_{M31} Mpc	$M^*_{\leqslant 2}$ per cent	$M^*_{\geqslant 8}$ per cent	M^*_{Total} $M_\odot$	$SFR_{\geqslant 12}$ $M_\odot\, yr^{-1}$
KKR 25	1.93±0.07	11	62	$3.0 \cdot 10^6$	$1.7 \pm 0.2 \cdot 10^{-3}$
KK 258	0.84±0.09	11	70	$2.2 \cdot 10^7$	$7.9 \pm 4.0 \cdot 10^{-3}$
KKs 03	2.12±0.07	12	74	$2.3 \cdot 10^7$	$8.7 \pm 0.4 \cdot 10^{-3}$
Tucana	0.92±0.02	0	81	$4.2 \cdot 10^6$	$1.6 \pm 0.2 \cdot 10^{-3}$
And XVIII	0.58±0.09	5	34	$4.2 \cdot 10^6$	$7.3 \pm 0.9 \cdot 10^{-4}$
And XXVIII	0.38±0.09	0	50	$2.3 \cdot 10^6$	$4.7 \pm 1.2 \cdot 10^{-4}$
Cas dSph	0.23±0.03	0.5	93	$2.4 \cdot 10^7$	$9.4 \pm 0.8 \cdot 10^{-3}$
And XXIX	0.20±0.02	0	86	$1.6 \cdot 10^6$	$4.2 \pm 1.3 \cdot 10^{-4}$

Есть ли эффект окружения? Да!

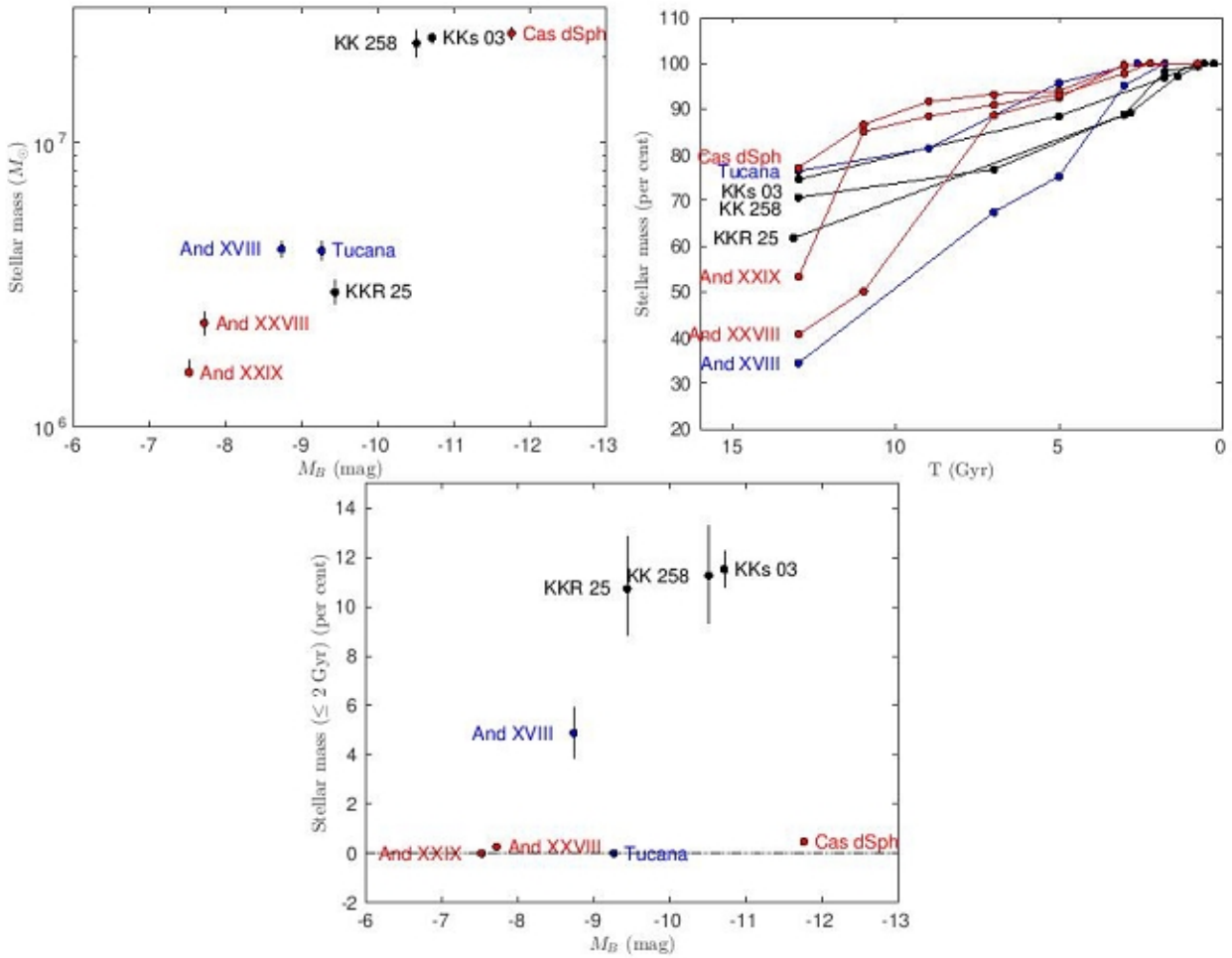


Figure 4. The upper left panel shows the measured total stellar mass for a sample of dwarf galaxies vs. the absolute magnitude in filter B; the upper right panel represents the cumulative stellar mass function for our sample; the lower panel of shows the stellar mass formed in the last 2 Gyr vs. the galaxy absolute magnitudes. Every galaxy signed, and in the colour version of this figure the isolated dwarf spheroidals are indicated in black, within the zero velocity radius of the M 31 – blue, and within the virial radius – red.